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## ABSTRACT

### THE RELATIONSHIP BETWEEN THE LEVEL OF NURSE STAFFING AND NURSING INCIDENTS

Susan Laird Helm, R.N., B.S.N., M.A.

Medical College of Virginia-Virginia Commonwealth University,  
1992

Major Director: Mary C. Corley, R.N., Ph.D

Determined the relationship between the level of nurse staffing and nursing incidents. The study was based on two samples: (1) nursing incident data (N=80) and workload management statistics for six nursing units; and (2) daily workload data (N=213) for one medical-surgical unit, regardless of incident occurrence. Data, for both samples, were separated into two groups based on levels of staffing, with one group comprising different levels of variant staffing, and one group recommended staffing.

Analysis of data revealed that at times of incident occurrence, variant staffing was the mode. The recommended and variant staffing levels for type of incident did not differ significantly.

In the second sample, eighteen incidents occurred. Incident occurrence was correlated with different levels of nursing care hour (NCH) variance, RN utilization rates and non-RN utilization rates. There was no statistically significant difference between the two staffing groups for the eighteen incidents or for type of incident. NCH variance and non-RN utilization rate were found to be statistically different in incident occurrence rates. ANOVA analysis found staffing levels were statistically different in the number of incidents occurring.

Further research is called for to assess more fully the relationship between staffing level and quality of care.

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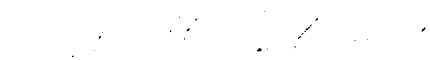
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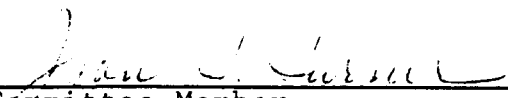
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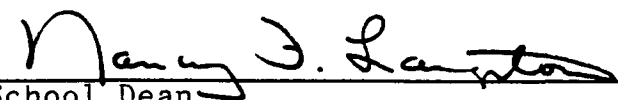
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\_\_\_\_\_  
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\_\_\_\_\_  
Committee Member

  
\_\_\_\_\_  
Committee Member

  
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Department Chairman

  
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School Dean

  
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Date

THE RELATIONSHIP BETWEEN THE LEVEL OF NURSE STAFFING  
AND NURSING INCIDENTS

A thesis submitted in partial fulfillment of the  
requirements for the degree of Master of Science  
at Virginia Commonwealth University

By

Susan Laird Helm, R.N.  
B.S., Nursing, St. Louis University, 1980  
M.A., Management, Webster University, 1983

Director: Mary C. Corley, R.N., Ph.D.  
Assistant Professor  
Department of Nursing Administration  
and Information Systems  
School of Nursing

Virginia Commonwealth University  
Richmond, Virginia  
May, 1992

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## ABSTRACT

### THE RELATIONSHIP BETWEEN THE LEVEL OF NURSE STAFFING AND NURSING INCIDENTS

Susan Laird Helm, R.N., B.S.N., M.A.

Medical College of Virginia-Virginia Commonwealth University,  
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Major Director: Mary C. Corley, R.N., Ph.D.

The study examined the relationship between the level of nurse staffing and nurse incidents. The study was based on two samples: (a) nursing incident data (N=80) and workload management statistics for six nursing units; and (b) daily workload data (N=213) for one medical-surgical unit, regardless of incident occurrence. Data, for both samples, were separated into two groups based on levels of staffing, with one group comprising different levels of variant staffing, and one group recommended staffing.

Analysis of data revealed that at times of incident occurrence, variant staffing was the mode. The recommended and variant staffing levels for type of incident did not differ significantly.

In the second sample involving daily workload data, 18 incidents occurred. Incident occurrence was correlated with different levels of nursing care hour (NCH) variance, RN utilization rates and non-RN utilization rates. There was no statistically significant difference between the two staffing

groups for the 18 incidents or for type of incident. ANOVA analysis found a greater number of incidents occurring at variant staffing levels ( $F = 2.19$ ,  $p = .0199$ ).

Further research is called for to assess more fully the relationship between staffing level and quality of care.

## Chapter 1

### INTRODUCTION

Planning for the delivery of efficient, quality nursing care is a formidable challenge. Payers no longer want to subsidize inefficient health care operations (Sandrick, 1986). Moreover, hospital managements now view labor as their most expensive line item. Since nursing services account for the majority of labor expense, they are most easily and often targeted for reform. If a hospital can increase its labor efficiency, its costs will decrease. This focus, however, raises an important question about the relationship between efficiency and the quality of care: When does the pursuit of labor efficiency move into the realm of underservice and undertreatment (Behner, Fogg, Fournier, Frankenbach, & Robertson, 1990; Sandrick, 1986)?

A number of nurse researchers have looked at the link between nursing resources and the quality of patient care in the context of demands for labor efficiency. The findings have been inconclusive. Some studies found no relationship between the level of nursing resources and the quality of care (Abdellah & Levine, 1958, 1979, cited in Abdellah & Levine, 1986; Aydelotte & Tenor, 1969, cited in Aydelotte, 1973; Hoffman, Jenkins, & Putney, 1990). Others, however, found a strong relationship (Behner et al., 1990; Blake &

Morfitt, 1986; Flood & Diers, 1988; Helt & Jelinek, 1988; Munroe, 1990).

The variation among these findings is due, in part, to the use of different definitions of both quality of care and staffing. Staffing can be the actual personnel available to provide care, a recommended number and ratio as determined by a patient classification system, or a variation of that ratio. This study examines data on nursing care demand and staff allocation according to a patient classification system, in order to cast light on issues of efficiency and cost.

#### The Patient Classification System: A Basis for Decisions on Nurse Staffing Levels

Patient classification is a tool that defines patients' requirements by measuring the degree of their dependency on nursing care, according to Halloran, Patterson, and Kiley (1987). They point out that the degree of dependency on care, affects both the patient's clinical management and the efficient management of the nursing department's resources, whose cost makes up 20-30% of total hospital expense. Kirk (1990) points out that with modification, a patient classification system can be used to manage and maintain high quality of care efficiently, although that is so only if the system is "built on clearly defined quality outcomes, staff-accepted responsibilities for contributing to these outcomes,

and specific and reasonable time targets for nurse contributions (p. 22).

Assuming that the measures of the quality clinical care are valid, monitoring it reveals instances when quality care has been sacrificed to meet efficiency or cost objectives (Ehrat, 1987). Thus, patient classification methods are useful not only in establishing the required staffing levels, but also in assessing the quality of the clinical care provided.

It should be noted, however, that in 1984, Giovannetti concluded that even though patient classification methods are widely endorsed and used by hospitals, a gap frequently remains between the levels and patterns requested for nurse staffing, and those allocated. The arguments among health care professionals over whose figures are reliable indicators will be resolved only when the incremental effect of specific staffing levels and patterns on the quality of care has been demonstrated (Giovannetti, 1984).

Jelinek (1988) analyzes how both productivity and quality depend on staffing as well as structural factors within the hospital. Included among the factors which may affect productivity and quality is staff mix, which can be set by using a patient classification system (Jelinek, 1988). The factors affecting productivity and quality are both structural and contextual according to Daft (1992), who emphasizes the need for proper structure to improve outcomes.

Clayton McWhorter, when he was president of Hospital Corporation of America, emphasized the importance of discovering whether changes in costs arise from the management quality side (structure) or the clinical quality side (process) of hospital operations (Sandrick, 1986). Included in management quality, according to McWhorter, are matters that affect patient care both directly and indirectly, e.g., staffing allocations, but also getting laboratory test results back to the physician promptly. Within the United States Air Force Nurse Corps today, the connection among structure, process, and outcomes continues to be an important issue (J. M. Black & P. S. Worrall, HQ USAF/SGN, personal communication, June 13, 1991). Nurse staffing in military medical treatment facilities has traditionally been based on data about the number of beds that had been occupied in a clinical area. In recent years, to meet Department of Defense criteria for accurate and fair allocation of staff, a patient classification system was developed. Using the patients' identified needs for nursing care, it determines the number and quality of nursing personnel needed. When patient requirements exceed available nursing personnel, however, Air Force hospitals have only a few ways to increase the supply. Often there are no "nursing pools" or agencies from which to obtain extra help in times of shortage. Then decisions have to be made about when nursing care is to be compromised and at what staffing level.

When should nursing administrators insist on patient diversion, limited admissions, or transfers? These ethically demanding and politically sensitive dilemmas create an urgent need for relevant research findings on which to base decisions. In the face of lost funding and staffing, reduced medical education and training opportunities, and lower levels of physician productivity, it is even more urgent to cast light on these issues.

#### Purpose Statement

Nurse administrators must be able to assess staffing needs accurately and communicate those needs effectively so they are met. The purpose of this study is to assess the relationship between the rate of nursing incidents and staffing adequacy on units in one medical treatment facility where staffing is based on patient acuity classifications. The following research questions were examined:

1. Does the rate of nursing incidents vary according to whether staffing levels are those recommended, or variant levels?
2. Is there a relationship between the rate of nursing incidents and the presence of variant staffing patterns?

#### Hypothesis

Using of recommended staffing levels will produce a lower rate of nursing incidents than variant staffing patterns will.

### Definition of Terms

**Nursing incidents** are reported medication errors or treatment errors, falls, nosocomial infections, postpartum hemorrhages, IV-related incidents, blood and blood product-related incidents, or patient/family/physician complaints about the nursing staff.

The **recommended staffing level** is the recommended staffing pattern for the actual patient workload in accordance with the patient classification system guidelines. These are in accordance with Department of Defense, Office of the Assistant Secretary of Defense (Health Affairs) recommendations.

**Variant staffing level** occurs when the nursing staff actually on duty varies from the recommended staffing level for the patient workload according to the guidelines of the patient classification system.

**Variance** is the statistical difference between the recommended staffing level and the variant, found by subtracting the number of patient care hours required by the patients' acuity levels from the number of patient care hours available (determined by the staff available to work). A value of 0 indicates a match between the patient-required hours of care and the number of staff hours available. A value less than 0 means the required hours were greater than the available hours (understaffed). A value greater than 0 means the available hours were greater than the required hours (overstaffed).

**Staff utilization** is a statistic expressed as a percentage, namely the ratio of the number of nurses required divided by the number of nurses available, multiplied by 100. The same formula is used to determine the percent of nonprofessional utilization. Similarly to variance statistics, a value of 100% indicates a match between required and available staffing, below 100% shows overstaffing, and above 100% shows understaffing.

#### Assumptions

1. Reported staffing levels accurately reflect the actual staffing levels.
2. Reported nursing incidents accurately reflect the majority of nursing incidents.
3. The recommendations for staffing patterns based on a patient classification system are valid and reliable.
4. The patient classification system is valid and reliable.

#### Limitations

1. Since the study uses a convenience sample, the study results cannot be generalized.
2. Both the efficiency of nursing staff and the number of nursing incidents are affected by many variables other than nursing staff levels, such as physician practice patterns, support system (computerization, ancillary staff), physical layout, staff morale, staff job satisfaction,

education, and care delivery model. This study does not address these variables.

#### Delimitations

1. The study used a convenience sample of six nursing units in one federally-funded health care facility.

2. In order to control for other variables which affect nursing incidents, only one facility was included in this study.

#### Conceptual Framework

This study uses a conceptual framework developed by a six-member task force during a study at San Joaquin Hospital. The complete framework is presented in the San Joaquin General Hospital Study (U.S. Department of Health, Education, & Welfare [DHEW], 1978).

Staffing is defined as

the provision of the appropriate amount and type of care by persons possessing the requisite skills to the largest number of patients possible in the most cost efficient and humanly effective manner consistent with desired patient outcomes. . . (DHEW, 1978, p. 69).

The framework links possible variables which may affect staffing programs, and cites the relationship between and the direction of the effects of these variables. A simplified

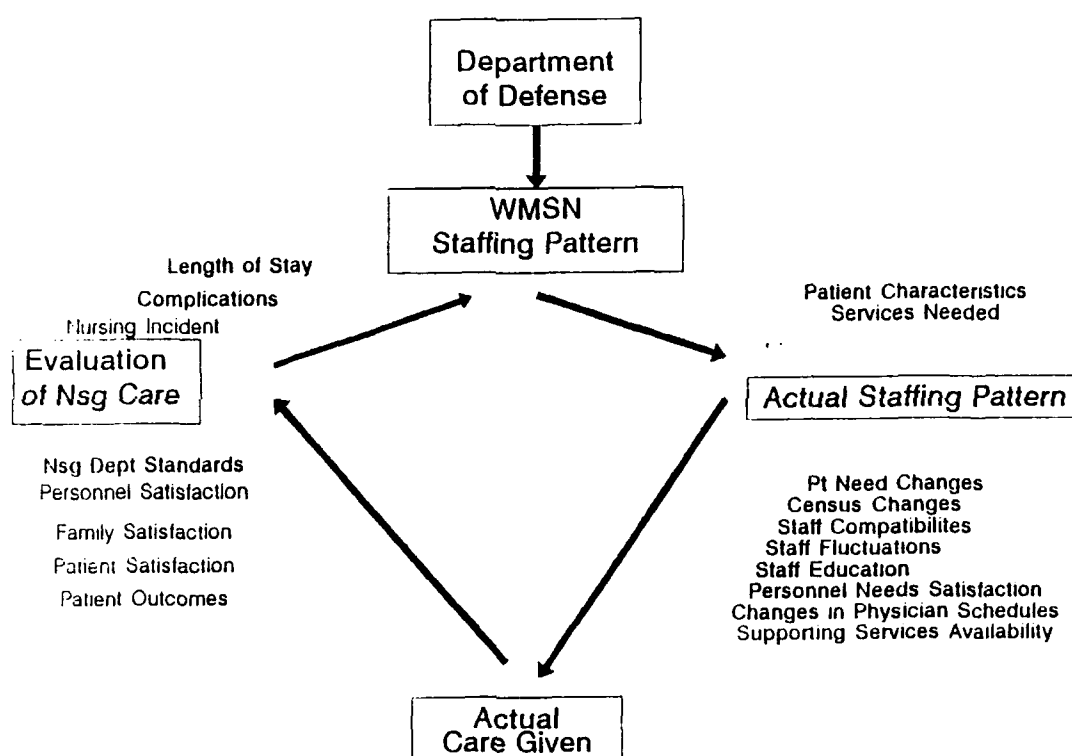
schematic representation of the framework for this study is presented in Figure 1.

The overall conceptual framework provides a context in which to view issues of staffing and nursing quality assurance. The numbers and kinds of variables in the framework, which can vary among institutions and among units in a given institution, show the major facets and the possible relationships among them that should be addressed when analyzing nurse staffing programs (DHEW, 1978).

Many of the same factors are cited by Helt and Jelinek (1988) and Jelinek (1988) in studies of the relationship between nurse staffing and quality of care. The San Joaquin study's framework is also consistent with structural contingency theory (Mark, 1989), which sees the fit between structure and technology as increasing organizational effectiveness. Certain structural dimensions similar to those specified by Helt and Jelinek (1988): automation/computerization, education and training of staff, organization, physical facilities, and environmental factors affect organizational effectiveness. Both theories recognize similar structural factors and outcomes as measures of quality or organizational effectiveness (e.g., patient outcomes and personnel satisfaction).

The right side of Figure 1 specifies the sorts of daily events that can affect actual care: patient need changes, census changes, staff fluctuation, staff education, and

## Conceptual Framework



*Adapted From DHEW, 1978*

Figure 1.

availability of supporting services. These changes can make the nursing care actually provided inconsistent with the ideal staffing pattern. Little can be done to alter these occurrences.

The left side of the figure shows how, in the process of evaluating nursing care, all groups within the hospital are interdependent. Actual care is measured against specific nursing standards; patient and personnel satisfaction are also evaluated. In the end, the total evaluation of care should feed back into plans for future staffing.

The conceptual framework can be summarized as follows: When the staffing pattern represents an actual number of nursing care hours made available to patients according to patient requirements, the patients have available the nursing care they need. The number of nursing incidents measures the quality of the care provided. Thus, if the appropriate number of caregivers is available, quality care, indicated by fewer nursing incidents, should result. According to Donabedian (1980), sufficient resources, along with proper system design, are probably the most important means of protecting and promoting quality of care. Thus, the greater the variance from the actual staff required, the higher the number of nursing incidents. Conversely, as the staff variance nears 0, nursing incidents occur less frequently.

## Chapter 2

### LITERATURE REVIEW

Studies on nursing incidents (falls, medication errors, and nosocomial infections) have included research on many factors: staffing adequacy, level of required care, staff morale, time of day, systems of medication administration, medication documentation systems, patient characteristics, patient attempts to satisfy needs, multiple medications, and staff interruptions (Blake & Morfitt, 1986; Garcia et al., 1988; Hill, Johnson, & Garrett, 1988; Hoffman, Jenkins, & Putney, 1990; Jones & Smith, 1989; Pearlson, 1988; Pollack & Whitty, 1990; Poster & Pelletier, 1988). Studies on nurse staffing have investigated patient satisfaction, staff satisfaction, hospital costs, and quality of care. Numerous researchers have explored the relationship between staffing and length of stay, patient outcome and cost, efficiency, and staff and patient satisfaction (Behner et al., 1990; Ehrat, 1987; Flood & Diers, 1988; Helt & Jelinek, 1988; Jelinek, 1988; Marchette & Holloman, 1986; Munroe, 1990; secondary reference, Aydelotte, 1973, and Abdellah, 1979).

No research studies that relate staffing levels and nursing incidents could be located. To encompass the factors that influence staffing and nursing incidents, the literature review included selective research on the use of staffing

methodologies, factors affecting nursing incidents, and related research on nurse staffing levels and patient and organizational outcomes.

### Staffing Methodologies

In a comprehensive review, Aydelotte (1973) cited books, theses, and research reports on staffing methodologies that documented the relationship between staffing and quality of care. The following sources cited by Aydelotte were considered to be important to this study, but either have not been published or are not in print. Abdellah and Levine (1958) studied the effect of nurse staffing on satisfaction with nursing care. They reported on patients' and nurses' sense of the inadequacy of nursing care, rather than on numerical shortages of nursing personnel. They concluded that no matter how many hours of nursing care were available, some groups among either the nursing staff or the patients felt aspects of nursing care were lacking. Significantly, obstetrical patients reported the same degree of unfulfilled needs regardless of the number or kind of nursing hours provided. This study measured patient and personnel satisfaction, which are organizational outcomes.

Nursing incidents, on the other hand, measure the quality of the process of nursing. Aydelotte and Tenor's 1960 study (cited in Aydelotte, 1973) found that neither augmented staff nor nurse education improved patient welfare.

They concluded that adding nurses was an inefficient way to provide more direct patient care. Aydelotte considered this research a forerunner to studies that measured the structural effects of the nursing department on patient care. In another study in this area, Feyerhern (cited by Aydelotte, 1973), developed formulae to predict patient care loads for personnel on various types of hospital nursing units. Working from the assumption that a minimal unit of time is required to perform nursing activities, and that the number of personnel required depends on the total time required to perform the activities required, he discovered that with more patient population but no additional staff, nurses either reduced the time spent in some activities, omitted some aspects of nursing care activities, or worked faster. The indication that workload limits had been reached was the reduction of communication and standby time to below a certain level. Although the study addressed the issue of how much staff was needed to care for patients, it provided no information about the implications of omitting certain nursing care activities.

In 1979, Abdellah and Levine concluded that no matter how many nursing hours were available, some groups would feel that aspects of nursing care were lacking. They had found that high levels of nurse staffing could hamper patient care. Bryant, Miller, and McConnel's study (cited in Abdellah & Levine, 1979) rejected the null hypothesis that there is no

significant difference in the number of omissions and of completed nursing tasks as staffing patterns or levels of nursing hours per patient vary.

These studies did much to justify research in quest of adequate staffing methodologies, and clarified the importance of matching patient requirements with nursing resources. However, they did not provide evidence about the relationship between staffing and the quality of patient care.

#### Staffing Factors and Nursing Incidents

Blake and Morfitt (1986) studied falls and other accidental injuries to elderly people in residential institutions. The distribution of falls by time of day was compared to staffing levels and was found to be statistically significant ( $p < .05$ ). The study found a negative correlation between the number of staff on duty and the number of falls. Although the staffing level thus might be one determinant of accident incidence, there was no correlation with a patient-required system of staffing levels, but only with the number of incidents.

A related study by Garcia et al. (1988) found a significant relationship ( $p < .05$ ) between falls and attempts of patients to satisfy elimination needs. The study also found relationships between falls and patient mobility, and falls and patient use of supports, both factors that are usually considered when assessing patient requirements for nursing care. The study did not address time of day or staffing.

Jones and Smith (1989) studied ways to prevent hospital incidents. The dependent variables included patient falls, treatment and testing errors, miscellaneous patient incidents, visitor incidents, and medication incidents. They reported outcomes statistically related to over a dozen independent variables including patient gender, race, age, diagnostic category, medication number, incident time, and location; the statistics, however, were not given. Despite this, two conclusions with implications for staffing can be cited: Frequent room checks are needed during certain time periods; and secondly, nurses should not be interrupted when administering medications. This study did not include staffing as an independent variable.

In another study, Hill et al. (1988) developed an integrated process to reduce falls. The researchers designed an assessment sheet to identify patients at a high risk for falling, and related data to day of admission, age, tour of duty, repeat falls, and multiple chronic medical diagnoses. In contrast to the findings in the Blake and Morfitt (1986) study, this study found that more falls occurred during the day shift. Again, staffing variance was not one of the independent variables studied.

Poster and Pelletier (1988) found a positive relationship between medication error rates and primary medication administration. An unsought finding was that medication error rates increased when nurses on the unit were

quite busy treating more acutely ill patients. The researchers concluded that staff stress levels may have contributed to this increase. Although increased acuity, patient needs and medication error rate were positively related, the staffing level was not considered.

Only one study looked directly at the relationship between infection rates and staffing adequacy (Hoffman et al., 1990). The researchers were unable to find a direct relationship between the degree of staff shortages and the infection rate. This study aggregated the data and compared infection rate per 1,000 patient days to staff percent utilization, where utilization less than 80% represented above-average staffing, and more than 120% reflected inadequate staffing. The difficulty with using infection rates lies in relating a specific infection to a particular staffing utilization rate. An important finding of the study showed that all infections occurred at above 110% utilization (below-average staffing).

#### Staffing in Relation to Other Patient and Organizational Outcomes

Other approaches to studying the nature of the relationship between nurse staffing and quality of care have included outcomes such as lack or delay in discharge planning, patient satisfaction, complications, length of stay, and infant mortality.

Marchette and Holloman (1986) analyzed data from medical records of 500 patients discharged from an acute care hospital in 1983. They found that for every area of discharge planning activity that nurses carried out, there was a decrease of 0.8 days of hospitalization, and for every day that discharge planning was postponed, there was an increase of 0.8 days of hospitalization. Although the study did not measure the adequacy of staffing levels or expertise of the nursing staff, it implied that if patient discharge needs are met, length of stay (LOS) can be reduced. The study's nonexperimental design, however, precluded examining the effect of other variables on LOS.

In 1988, Helt and Jelinek conducted a descriptive study analyzing over 8 million patient days in the Medicus National Data Base. During the period of January 1983 to December 1986, they found a significant drop in LOS but an increase in patient acuity, as well as in nursing productivity and quality. Helt and Jelinek concluded that the decreased LOS was a result of financial pressures and more competent nursing management. Productivity was measured using an index of actual hours per workload. Quality was measured using the Quality Monitoring Methodology developed by the authors. Their results suggested that reducing staff can result in higher quality. Their data showed an overall increase in the use of registered nurses (RNs) even in the face of staff reductions, and also that changing staffing levels attain a

point of optimal quality past which quality can decline through either understaffing or overstaffing. The authors conclude that only if overstaffing has occurred does reducing resources improve quality, and then only if other functions are changed, such as automation, education and training, organization, motivation, physical facilities, staff mix and environmental factors.

Flood and Diers (1988) identified two Diagnosis Related Groups (DRGs) in which nurse staffing made a difference in patients' LOS. When nursing units could not maintain adequate levels of staffing, patients had a higher complication rate (e.g., infections, including gangrene and urinary tract infections; heart conditions, including congestive heart failure and arrhythmias; and gastrointestinal disorders, including hemorrhage), a higher acuity level (probably due to the higher complication rates), and longer LOS. The authors recommended further research to explore the relationship between the incidence of nursing complications (nosocomial infections, urinary tract infections, falls, and medication errors) and the availability of nursing care. The drawback in this study is its use of aggregate data. It compared units having adequate staffing and those with less-than-adequate staffing, but did not provide utilization percentages or investigate a direct relationship between utilization percentage and complication.

In a related study, Behner et al. (1990) analyzed the relationship between nurse staffing levels and patient LOS.

They found that understaffing by 20% during the first three full days of the patient's stay increased by 30% the probability of contracting a clinical complication (e.g., spinal headache, prolonged postoperative pain, muscle spasm, wound infection, rash, abdominal distention requiring nasogastric tube, paralytic ileus, episode of nausea and/or vomiting lasting more than 24 hours, urinary retention, and urinary tract infection). The additional costs associated with patients who developed complications were greater than the labor savings due to understaffing. This study suggested that a threshold could be established for nursing units, below the standard, that could increase labor efficiency without jeopardizing the quality of patient care. Such understaffing could, however, reduce satisfaction for both nurses and patients, and could increase nurse turnover. Although the researchers used a utilization percentage, the dependent variables they studied were all clinical complications, not nursing incidents.

Stilwell, Szczepura, and Mugford (1990) performed a retrospective study of maternity hospitals to examine the relationship between staffing and perinatal deaths. Regression analysis found no identifiable relationship between nursing staff categories and the rate of perinatal deaths. The study did not address staffing utilization percentages

In a related study, Pollock and Whitty (1990) investigated ancillary staffing levels in hospital kitchens during an outbreak of food poisoning. The authors thought poor food handling was due to low morale; there were staff shortages and the staff worked double shifts for long periods without time off. The study concluded that good quality of care and service cannot be achieved without adequate ancillary staffing. Although this study investigated staffing adequacy in connection with the food poisoning outbreak, it did not address utilization percentage or nursing.

Munroe (1990) examined the influence of registered nurse staffing on the quality of nursing home care, represented as a function of nursing staff configuration, resident case mix, facility size, payer mix, average daily cost, ownership, nursing personnel salary, turnover, and profit. The study hypothesized that better quality would be observed in facilities that used higher proportions of RNs to LVNs. When other variables were controlled, there was a significant positive relationship between RN hours and the quality of care in the facility. In particular, the mix of nursing personnel appeared to be more important than the number of nurses available. Staff turnover was another significant variable in quality; not surprisingly, as turnover increased, the quality of care decreased because of the discontinuity of services and the poor morale of the remaining staff, who had

to adjust their workloads. This multifactorial regression study contributed information on which variables are the most significant in predicting a facility's quality of care, but it did not address staff variance or measure quality of nursing care.

Igersoll, Hoffart, and Schultz (1990) have reviewed the current status of health services research in nursing and its future directions. They concluded that comprehensive cost-benefit and cost-effectiveness analyses must be completed quickly. They saw studies on the interactive effects of structure, process, and outcome as crucial to the improvement of health services in nursing. "Nursing must know not only what outcomes occur, and why, but also how intended and unintended outcomes result, whether positive or negative" (p. 233).

#### Summary

Previous research implies that nurse staffing is an important factor in the quality of patient care, and in some cases is linked to length of stay. Widespread use of patient classification methods provides managers with tools to decide on staffing. The relationship between staffing and final outcomes, however, has not been clearly defined.

To date, research has been conducted on staffing and various outcomes. Number of staff on duty has been significantly correlated with patient falls; staffing

variance was not addressed. The one study (Hoffman et al., 1990) which examined staffing variance and number of infections found no statistical relationship; however, it did show that all the infections occurred when utilization had risen above 110%.

Marchette and Hollomon (1986), Helt and Jelinek (1988), Flood and Dier (1988), and Behner et al. (1990) found positive correlations between staffing variance and organizational outcomes such as increased productivity, shorter LOS, and increased labor efficiency. Many of the researchers recommended further studies on nurse staffing variance and other outcomes, such as nursing incidents. Staffing allocations affect both the quality of patient care and the quality of hospital management. In today's cost-conscious health care environment, it can be extremely useful when allocating nursing staff to understand how structure relates to process and outcomes of nursing care. By identifying a threshold of appropriate staffing, the nurse executive can help to ensure high quality of care for patients.

### Chapter 3

#### METHODOLOGY

The purpose of this study was to determine the relationship between the level of nurse staffing and the number of nursing incidents. Appropriate staffing plays an important role in the effectiveness of nursing services. Studies have shown that appropriate staffing can decrease length of stay (LOS), costs, and complications (Behner et al., 1990; Ehrat, 1987; Flood & Diers, 1988; Marchette & Holloman, 1986). Air Force nurse managers, nurse administrators, staff nurses, health administrators, and physicians need to know more about how nursing structures and processes influence health care quality, access, and cost (the three major areas of outcome in military as well as civilian health care) (J. M. Black & P. S. Worrall, HQ USAF/SGN, personal communication, June 13, 1991). The need for nursing care is the primary reason for admission to a hospital (Dr. J. Turner, 1990). Discovering the effect of nurse staffing patterns on the quality of nursing services provided will help nurse executives make improved staffing decisions, eventually improving cost efficiency and quality of care. This study will provide information on the relationship between nurse staffing levels and nursing

incidents, an indicator of quality of care. This information will enable nurse managers to make better decisions regarding the use of variant staffing patterns and to what degree variance will minimize nursing incidents.

### Research Design

A pre-experimental, ex post facto design (Polit & Hungler, 1987) was used to compare the rate of nursing incidents on units that used the recommended staffing pattern based on patient classification, and on units using variant staffing patterns. Because some extraneous variables are not controlled, threats to internal and external validity may affect the quality and interpretation of the data. To control for intrinsic differences in the independent variables, subject homogeneity was used (one facility using the same physicians with similar practice patterns, equal support services). Extrinsic (extraneous) variables were controlled to some extent through the use of similar settings--all nursing staff classify patients on the unit, at the same time.

### Setting, Population and Sampling

#### Setting

This study was conducted in a military health care facility located in a metropolitan area in southeastern United States. The facility offers both inpatient and outpatient services to all military beneficiaries within a 60

mile radius. A total of 68 full-time registered nurses and 102 medical technicians were employed by the facility at the time of the study. The nursing staffing pattern on all units was three 8-hour shifts or two 12-hour shifts.

### Population

The study population consisted of six nursing units within the health care facility, which are staffed by registered nurses, licensed practical nurses and medical technicians. Skill levels vary from RN to minimally skilled medical technicians (90230) and experience ranges from 0 to 30 years. Education ranged from professional nurses with master's degree to high school graduates with skills training.

### Sample

To facilitate data collection, two convenience samples were used. The first sample consisted of all nursing incidents which occurred during an 18-month period on six units in one facility. It was obtained by reviewing the hospital's incident reports and nursing unit daily workload management summary sheets from June 1990 to December 1991. This sample consisted of 80 incidents from six units.

Analysis revealed the need for additional sampling of workload data. Another retrospective review of one medical-surgical unit's daily 24-hour workload management summary

sheets for June 1990 to December 1990 collected data comprising the second convenience sample of 213 24-hour periods, in which 18 incidents occurred.

### Instrumentation

Workload management is a methodology that allocates staff to a nursing unit using a factor-evaluative patient classification system to establish the number of nursing care hours each patient needs. The staffing system then calculates the number and skill levels of personnel needed. The patient classification system has been tested for reliability and validity.

The validity of the patient acuity categories and the direct care time needed for each was established in studies at 11 large military health care facilities. In the 1968 Vail study of Army treatment facilities, the Pearson Product Moment correlation coefficient between the system and the Sherrod Nursing Care Hours Standards (NCHS) study tool was .81. When adjusted for emotional-support critical indicators (not incorporated in the NCHS tool), the correlation was .89. The system provides a consistently accurate measurement of required staff. Inter-rater reliability yielded a Pearson Product Moment coefficient of .93 between staff nurses and investigators. Inter-rater reliability between categories using the Goodman-Kruskal Gamma was .96 between staff and investigators, and .99 between investigators.

In the 1985 Reider and Jackson study in Naval treatment facilities, the overall rating between the staff and the investigation was .85, with a Kappa statistic of .78. The internal consistency reliability of the factors was determined using the Intra-Class Correlation Coefficient and was .96 overall (Joint Manpower Office, Office of the Assistant Secretary of Defense [Health Affairs], 1989).

In this study, inter-rater reliability for the workload management data on all units was consistently higher than .85 during the period studied. Inter-rater reliability was tested monthly.

The six nursing units studied use a workload management system based on certain health care criteria to establish unit-specific nursing care hour (NCH) requirements. The NCHs needed are then converted into a recommended number and mix of nursing personnel. The workload management summary sheet records daily the number of patients in each category on a nursing unit, the number of nursing care hours required, the recommended staffing for each shift, the staff actually scheduled on each shift, and any variance between recommended and actual staffing. All changes to the schedule are recorded, so the number of personnel who actually worked on each shift is documented.

Variance was identified as the difference between actual caregiving hours and the recommended standard. Variance can be interpreted in two ways. For example, if the patient-

required standard was 92 hours of care but the actual number of staffed hours was 73, one could conclude that the caregivers worked efficiently, and in 73 hours provided 92 hours worth of care. The other possible interpretation is quite otherwise, the quality of care was diminished and the likelihood of a nursing incident increased, since only 73 hours were available when 92 hours were needed.

Incident reporting is regulated by hospital policy. The incident form, in use for several years, included unit identification, date and time of incident occurrence, description of incident, names of witnesses, and patient identification numbers. Reports are completed as soon as possible after the incident and sent through administrative channels for review and action. The hospital quality improvement department decides the final disposition.

#### Procedures

This study was conducted during January 1992, using data from June 1990 through December 1991 to obtain a large enough sample (30 incidents) for the first sample. The second sample only used data from June 1990 through December 1990 (213 periods). Permission to conduct the study was obtained from the organization where the sample population was located (Appendix A). The nurse executive of the facility's corporate headquarters, the chief executive officer, and the director of nursing approved the study. A data collection

form (Appendix B) was designed for both data collection and entry into a database for analysis.

Data on workload were collected from workload management summary sheets. Data on nursing incidents were collected from hospital reports. Each incident was classified under one of the following categories: patient fall, medication error, nosocomial infection, postpartum hemorrhage, procedure error, IV-related incident, blood-related incident, patient/physician complaint about staff, and other. Other variables were patient age, gender, general diagnostic category (postpartum, medical-coronary heart disease, surgical, medical-other, pediatric, other), day of week, patient census at time of incident, average patient acuity at time of incident, and patient location.

#### Data Analysis

Data were reported by (a) incidents for the total time frame, (b) periods for one unit, and (c) levels of staffing. Frequency distributions were determined for each of the variables studied.

In the first sampling the incident data were divided into two groups: those that occurred when the recommended staffing and the actual staffing were equal, and those that occurred when there was a variance from the recommended staffing.

The second sampling summarized workload data using descriptive statistics for NCH hours, RN and non-RN

utilization rates, average acuity, census and required NCHs. The sample's central tendency, dispersion on each variable, and frequency distribution were then measured.

The workload data were divided into two groups: workload when incidents occurred, and workload when no incidents occurred. The Pearson correlation coefficient was used to identify relationships between the variables. Cross-tabulation determined the strength of association between variables. Since the dependent variable was nominal data, Lambda  $y_x$   $x_y$  and Cramer's V were used to interpret this association.

To analyze the difference between the two workload data groups (with incidents and without incidents), the study used the t-test for difference of means between two independent samples. Analysis of variance was also calculated for incident occurrence at different staffing levels.

Both linear and nonlinear regressions between staffing variance and occurrence incidents were conducted. To increase the confidence of data interpretation, the coefficient of determination ( $R^2$ ) was used. The level of significance for all statistical tests was placed at .05.

## Chapter 4

### PRESENTATION OF DATA

A pre-experimental, ex post facto design (Polit & Hungler, 1987) was used to analyze nursing incident rates on six nursing units in one 70-bed medical treatment facility over the 18-month period, June 1990-December 1991. The study compared rates on units using recommended patient classification staffing patterns and on units using variant patterns. Study results include descriptive data on 80 nursing incidents, and analysis of the relationships between the variables and the occurrence of nursing incidents.

Data from the 80 nursing incident reports as well as workload summaries were analyzed by frequency statistics. Since the data were a mix of nominal and interval levels, and not normally distributed, nonparametric statistics were used for further analysis. Frequency statistics were calculated for the following data: incident type, nursing care hour (NCH) variance, unit, shift, day of week, RN utilization rate, non-RN utilization rate, census, and average patient acuity. Pearson's chi-square test and ANOVA were used to test for difference in rate of incidents between staffing patterns and NCH variance. Correlation statistics were used to identify relationships between variables. Linear and nonlinear regressions were used to explain the variance between staffing levels for incident rates.

### Characteristics of Nursing Incidents

Descriptive data were gathered on the following variables: type of incident, unit, census, average patient acuity, shift, day of week, NCH variance, RN utilization rate, and non-RN utilization rate. Table 1 shows the frequency of incidents analyzed for each of these variables.

#### Type of Incident

The types of incident reported were medication errors, patient falls, patient/physician complaints, other, procedure errors, and IV-related incidents. No nosocomial infections or blood or blood product-related incidents were reported during the study time frame. Forty incidents (50%) were medication errors, the most frequently reported type. An additional 17 incidents (21.3%) were patient falls. These two types of incidents accounted for over 70% of all incidents. Other types were patient/physician complaint (16.2%), other (7.5%), procedure error (3.7%), and IV-related incidents (1.2%).

#### Unit

Six nursing units were studied. The two medical-surgical units had the highest number of incidents: The first unit with 31 (38.8%) and the second unit with 21 (26.3%). These two units were followed by the special care unit (SCU) with 9 (11.2%); postpartum with 8 (10%); nursery with 7 (8.7%); and other with 4 (5%) incidents.

Table 1

Incident Rate by Type, Unit, Census, Average Acuity, Shift,  
Day of Week, NCH Variance, RN Utilization Rate, and Non-RN  
Utilization Rate, at Time of Incident, by Frequency and  
Percent, June 1990-December 1991 (N=80)

<b>Characteristic</b>	<b>N (%)</b>
<b><u>Type</u></b>	
Medication Error	40 (50)
Patient Fall	17 (21.3)
Patient/Physician Complaint	13 (16.3)
Other	6 ( 7.5)
Procedure Error	3 ( 3.7)
IV-Related	1 ( 1.2)
<b><u>Unit</u></b>	
Medical Surgical A	31 (38.8)
Medical Surgical B	21 (26.3)
SCU	9 (11.2)
Postpartum	8 (10)
Nursery	7 ( 8.7)
Other	4 ( 5.0)
<b><u>Census</u></b>	
1 - 5	13 (16.2)
6 - 10	17 (21.3)
11 - 15	22 (27.5)
16 - 20	15 (18.8)
21 - 35	13 (16.2)
<b><u>Average Acuity</u></b>	
1.25 thru 1.99	23 (28.7)
2.00 thru 2.50	37 (46.3)
2.51 thru 3.00	10 (12.5)
3.01 thru 3.99	2 ( 2.5)
4.00 thru 5.00	8 (10.0)
<b><u>Shift</u></b>	
Days (7-3)	38 (47.5)
Evenings (3-11)	22 (27.5)
Nights (11-7)	20 (25.0)

Table 1 (continued)

<b>Characteristic</b>	<b>N (%)</b>
<b><u>Day of Week</u></b>	
Sunday	9 (11.2)
Monday	13 (16.3)
Tuesday	14 (17.5)
Wednesday	16 (20.0)
Thursday	11 (13.8)
Friday	8 (10.0)
Saturday	9 (11.2)
<b><u>NCH Variance</u></b>	
-84 thru -33	7 ( 8.7)
-25 thru -32	5 ( 6.3)
-17 thru -24	6 ( 7.5)
- 9 thru -16	5 ( 6.3)
- 1 thru - 8	9 (11.3)
0	32 (40.0)
1 thru 8	12 (14.9)
9 thru 16	2 ( 2.5)
17 thru 36	2 ( 2.5)
<b><u>RN Utilization Rate</u></b>	
.25 thru .99	31 (38.8)
1.00	37 (46.2)
1.10 thru 3.5	12 (15.0)
<b><u>Non-RN Utilization Rate</u></b>	
.00 thru .88	26 (32.5)
1.00	44 (55.0)
1.40 thru 2.5	10 (12.5)

### Census

The special care unit (SCU) is limited to a bed capacity of four, while other units can house 14 to 35 patients. Twenty-two incidents (27.5%) occurred when census was between 11 and 15 patients. At the high end of the census range, more than 21 patients, 13 incidents (16.2%) occurred. The other incidents occurred at census ranges of 1 to 10, and 16-20.

### Average Patient Acuity

Patient acuity can range between 1.00 and 6.00. Twenty-three incidents (28.7%) occurred at average acuity levels of less than 1.99. Eight incidents (10%) occurred at acuity range of 4.00 to 5.00. The remainder of the incidents occurred in the range of 2.00 to 3.50.

### Shift and Day of Week

Nursing units staff in 8-hour shifts. More incidents (47.5%) happened on the day shifts (7:00 a.m. - 3:00 p.m.) than on evening or night shifts. Incidents occurred on each day of the week. The most incidents, 16 (20%), occurred on a Wednesday. Friday had the fewest incidents (n=8, or 10%).

### NCH Variance

Of the 80 incidents, 32 (40%) occurred when there was no NCH variance from the recommended standard. Forty-eight incidents (60%) occurred when there was a NCH variance. The NCH variance is expressed in terms of 8 hours of care, which

in the facility is one full time equivalent (FTE). Of the incidents which occurred during variant staffing levels, 32 (66%) occurred when units were short by one or more FTEs (see Figure 2). When units were overstaffed by two or more FTEs, only five incidents (10%) occurred. This finding is significant, showing that more incidents occur with variant staffing and more occur during understaffed periods than during overstaffed periods. With both overstaffing and understaffing by one FTE, incidents rose to 54 (66%). This finding suggests it is ideal staffing, according to the workload management system, that keeps incidents to a minimum, although it should be noted that during periods of understaffing more incidents occurred than during periods of overstaffing.

#### RN Utilization Rate

RN utilization rates (ratio of patient-required RNs to actual RNs) ranged from .25 to 3.50. Thirty-seven incidents (46.2%) occurred when RN utilization was 1.00, or at the recommended staffing for RNs. At rates of less than 1.00 (overstaffing), 31 incidents (38.8%) occurred; and at rates of more than 1.23, 12 incidents (15%) occurred. The lower rate of reported incidents with RN understaffing and higher rate with overstaffing may be due to nurses having the time to identify problems and/or fill out incident reports.

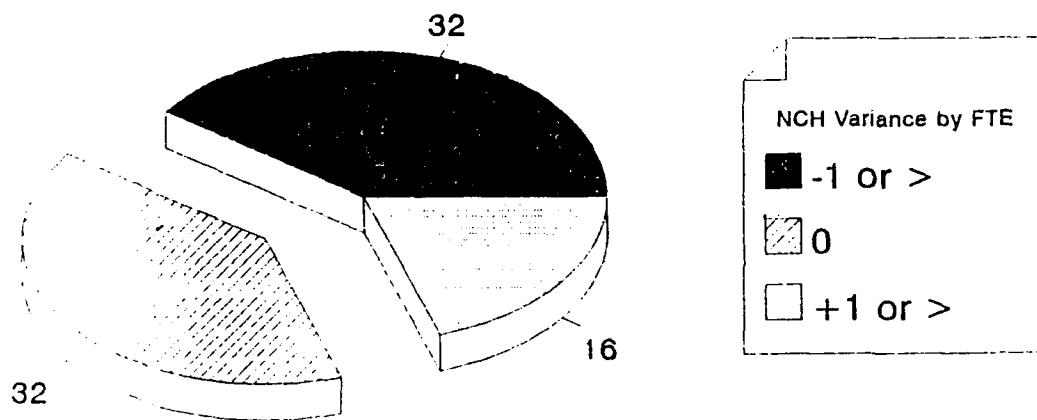


Figure 2. NCH variance (by staffing) and incidents.

### Non-RN Utilization Rate

The non-RN utilization rates ranged from .00 to 2.50. Forty-four incidents (55%) occurred at 1.00. At  $< 1.00$ , 26 incidents (32.5%) occurred; and at  $> 1.00$ , 10 incidents (12.5%) occurred. Again, more incidents were reported with overstaffing than with understaffing.

Comparing the relationship of each utilization rate to the number of incidents reveals that fewer incidents occurred when the RN rate was 1.00 than when non-RN rate was 1.00. The implication is that of the two types of utilization having a RN utilization rate that meets the recommended standard is preferable (see Figure 3).

Table 2 shows the average, standard deviation, and range for NCH variance, RN utilization rate, non-RN utilization rate, census and average acuity at the time of an incident occurrence. Incidents occurred at NCh variances ranging from -84.00 hours through +36.00 hours. The RN utilization rate, with 1.00 as the standard, ranged from a minimum of .25 to a maximum of 3.5. The non-RN utilization rate ranged between .00 and 2.5. RN NCH variance ranged from -28 hours to +20 hours, positive figures indicating that more RNs were available than needed. Census at the time of an incident ranged from 1 to 35 patients. Average patient acuity on the unit at the time of incident, on a scale of 1.00 to 6.00, ranged between 1.25 and 5.00.

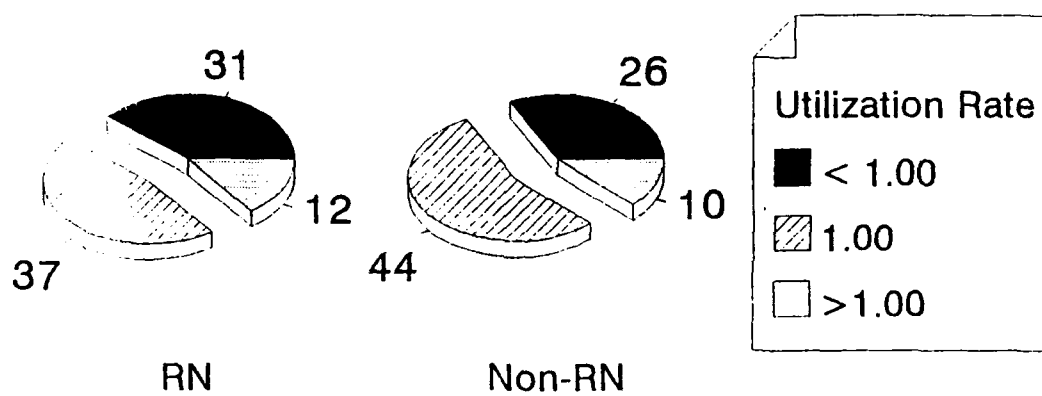


Figure 3. Comparison of incidents by utilization rates

Table 2

NCH Variance, RN Utilization Rate, Non-RN Utilization Rate, RN NCH Variance, Census, and Average Acuity at Time of Incident, June 1990-December 1991 (N=80)

<b>Variable</b>	<b>Mean</b>	<b>±SD</b>	<b>Range</b>
NCH Variance	-7.27	±18.10	-84.00-36.00
RN Utilization Rate	.97	± .52	.25- 3.5
Non-RN Utilization Rate	.94	± .46	.00- 2.5
Census	13.54	± 7.53	1- 35
Average Patient Acuity	2.36	± .83	1.25- 5.00
RN NCH Variance	-2.37	± 7.71	-28- 20

### Incident and Nursing Care Hour Variance

Table 3 shows the variance in each kind of nursing care hours for each type of incident. All the incidents occurred with negative mean NCH. Procedure incidents occurred with the most negative care-hour variance for each personnel group. In the RN NCH variance category, the type of incident associated with the most negative care-hours was patient falls, followed in descending order by, other, patient/physician complaint, and medication error. In the categories of total NCH variance and non-RN NCH variance, complaints were associated with the most negative hours, followed by patient falls, medication errors and other. An interesting finding is that medication errors, the type most frequently reported, occurred with the least total--NCH, RN-NCH and non-RN NCH variances.

Table 4 compares incidents during periods of recommended staffing levels and of variant staffing levels. Recommended staffing was defined as no variance (0.00). Variant staffing was NCHs more or less than 0.00 hours. The incident rates at the recommended and the variant staffing levels were compared for type of incident, unit, census, average patient acuity, shift, RN utilization rate, and non-RN utilization rate. Thirty-two incidents (40%) occurred at recommended levels and 48 incidents (60%) occurred at variant levels.

More patient falls, medication errors, procedure errors, and patient/physician complaints occurred at variant than at

Table 3

NCH Variance by Personnel Category for Each Type of Incident forAll Units, June 1990-December 1991 (N=80)

Incident Type	Category					
	Total NCH		RN NCH		Non-RN NCH	
	Mean	SD	Mean	SD	Mean	SD
Patient Fall	- 7.76	±25.04	-2.82	± 9.03	- 4.94	±16.58
Medication Error	- 5.6	±15.91	-2.1	± 7.52	- 3.5	±10.53
Procedure	-13.87	±22.65	-3.2	±11.54	-10.67	±12.22
Complaint	-11.69	±16.85	-2.46	± 8.25	- 9.23	±12.58
Other	- 5.33	±14.01	-2.67	± 4.13	- 2.67	±14.9

Table 4

Frequency of Incidents Compared at Recommended and at  
Variant Staffing Levels by Type of Incident, Unit,  
Census, Average Acuity, Shift, RN Utilization Rate,  
Non-RN Utilization, June 1990-December 1991 (N=80)

Factor	<u>Staffing Level</u>	
	Recommended (n=32)	Variant (n=48)
<b><u>Incident Type</u></b>		
Patient Fall	7	10
Medication Error	14	26
Procedure Error	1	2
IV-related	1	-
Patient/Physician Complaint	6	7
Other	3	3
<b><u>Unit</u></b>		
Medical-Surgical A	5	26
Medical-Surgical B	8	13
SCU	4	5
Nursery	4	3
Postpartum	8	0
Other	3	1
<b><u>Census</u></b>		
1 - 5	8	5
6 - 15	19	20
16 - 35	5	23
<b><u>Average Acuity</u></b>		
1.00 - 1.96	13	10
1.97 - 2.29	7	21
2.3 - 2.99	7	12
>3.0	5	5
<b><u>Shift</u></b>		
Day	10	28
Evening	10	12
Night	12	8
<b><u>RN Utilization Rate</u></b>		
.25 - .99	1	30
1.00	29	8
1.1 - 1.5	2	10
<b><u>Non-RN Utilization Rate</u></b>		
.00 - .99	2	24
1.00	29	15
1.01 - 2.5	1	9

recommended staffing levels. Only one IV-related incident occurred with a recommended staffing level. Other incidents were equally divided between times of recommended and of variant staffing.

Half of the units (special care unit, both medical-surgical units) had more incidents with staff variances than with recommended staffing levels. The maternity units (nursery, postpartum, other) had more incidents with recommended staffing levels.

At census levels below five, more incidents occurred with recommended staffing levels. When census reached more than six, more incidents occurred with variant staffing levels.

With acuity low (1.00-1.96), more incidents occurred when staffing was at the recommended level. In the middle range of acuity (1.97-2.99), more incidents occurred at variant staffing levels. When acuity was  $> 3.00$ , incidents were evenly distributed between recommended and variant staffing levels.

On the day and evening shifts, more incidents occurred with variant staffing levels. On the night shift, more incidents occurred with recommended levels.

For both RNs and non-RNs, 29 incidents occurred when staffing levels were appropriate. When the non-RN utilization rate was appropriate (1.00), but RN staffing was variant, 15 incidents occurred. However, when RN utilization

rate was 1.00 but there was a staffing variance for non-RNs, only eight incidents occurred. This reinforces the idea that recommended RN staffing is more important than recommended non-RN staffing (see Figure 4).

#### Relationship Between Descriptive Variables, NCH Variance and Utilization Rates

The Pearson Product Moment correlation coefficient was used to determine the direction and strength of the relationships between RN utilization rate, RN-NCH variance, non-RN NCH variance, census, NCH variance, average acuity, and non-RN utilization rate. Table 5 illustrates intercorrelations for these study variables (N=80).

A moderate correlation was seen between RN utilization rate and NCH variance ( $r = .637$ ,  $p = .01$ ), suggesting that the higher NCH variance was related to understaffing of RNs. The moderate correlation between RN-NCH variance and non-RN NCH variance indicated that RN and non-RN utilization increased or decreased together ( $r = .567$ ,  $p = .01$ ). RN and non-RN utilization rates had a moderate correlation level, i.e., both RNs and non-RNs were understaffed or overstaffed at the same time.

Census and average acuity had a low negative correlation. As census went up, average acuity decreased. The low negative correlation ( $r = -.414$ ,  $p = .01$ ) between census and non-RN utilization rate meant that as census increased, non-RNs became more overstaffed. The inverse

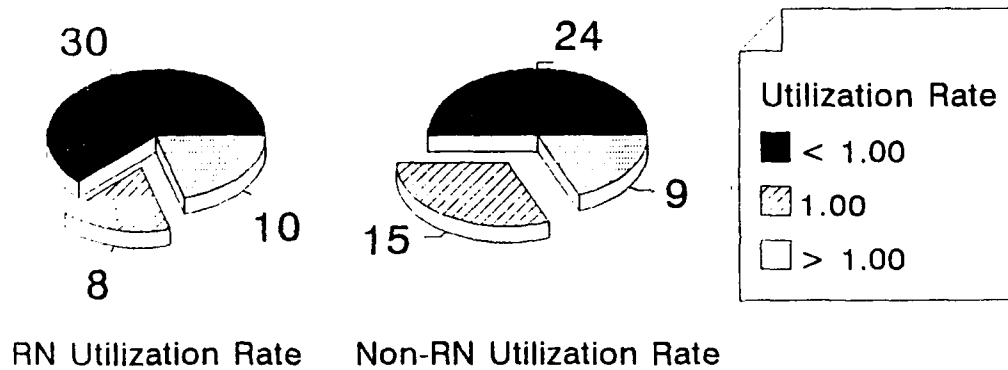


Figure 4. Comparison of incident frequency by rate at variant staffing

Table 5

Pearson Correlation Coefficients for NCH Variance, RN Utilization Rate, RN-NCH Variance, Non-RN Rate, Non-RN NCH Variance, Census, and Average Acuity with Level of Significance

Variable	NCH Variance	RN Rate	RN NCH Variance	Non-RN Rate	Non-RN NCH Variance	Census	Average Acuity
NCH Variance	1.00	-0.160	-.293**	-0.215	-.295**		0.006
RN Rate	.637**	1.00		.335**		-0.052	-.459**
RN NCH Variance	-.293**		1.00		.567**		-.312**
Non-RN Rate	.414**	.335**		1.00		-.414**	-0.116
Non-RN NCH Variance	-.295**		.567**		1.00		-.328**
Census		-0.052		-.414**		1.00	-.328**
Average Acuity	0.006	.637**	-.312**	-0.116		-3.28**	1.00

\* p = .05; \*\* p = .01

correlation between average acuity and RN-NCH variance and RN utilization rate showed understaffing of RNs to be associated with decreasing acuity.

#### Acuity and Utilization Rates

Table 6 details the t-test results the RN and non-RN utilization rates, and average acuity for the two different staffing levels. Only non-RN utilization rate resulted in a significant difference between recommended and variant staffing levels. No significant difference occurred between the two staffing levels for RN utilization rate or average acuity.

Table 7 shows the chi-square analysis of staffing level variance and unit, RN utilization rate, non-RN utilization rate, average acuity, census, day of week, and shift. In order for the chi-square test to be valid for this analysis, the variables were recoded into groups reducing the number of cells with observed counts fewer than five. As most of the data were nominal, Cramer's V was chosen to measure the degree of departure from statistical independence. If that was significant, Lambda was used to reduce the error in predicting staffing variance within each category. To obtain the staffing level variable, NCH variance data were recoded into two groups. Recommended staffing was at 0.00 hours variance, and other levels of NCH variance were grouped under variant staffing. Staffing level was significantly different for unit, RN and non-RN utilization rates, and shift.

Table 6

Analysis of Utilization Rates and Acuity Between  
Recommended and Variant Staffing Levels for All  
Incidents, June 1990-December 1991 (N=80)

Variable	Recommended Staffing (n=32)		Variant Staffing (n=48)		F	P
	Mean	SD	Mean	SD		
Non-RN Rate	1.97	.31	1.69	.78	6.29	.027
RN Rate	4.63	.67	3.56	1.89	7.98	.098
Average Acuity	3.41	2.76	3.48	2.35	1.37	.903

Table 7

Analysis of Staffing Level and Unit, RN Utilization Rate, Non-RN Utilization Rate, Average Acuity, Census, Day of Week, and Shift for All Units, June 1990-December 1991 (N=80)

	<u>Staffing</u>				
Variable	Recommended	Variant	Cramer's V	P	Lambda
<u>Unit</u>					
Medical-Surgical A	5	26			
Medical-Surgical B	8	13			
SCU	4	5	.529	.000	.34
NBN	4	3			
Postpartum	8	-			
Other	3	1			
<u>RN Utilization</u>					
.25	-	1			
.26 - .5	1	18			
.51 - .99	-	11			
1.00	29	8	.760	.000	.69
1.1 - 1.25	1	-			
1.26 - 1.5	-	1			
>1.5	1	9			
<u>Non-RN Utilization</u>					
< .99	2	24			
1.00	29	15	.585	.000	.44
>1.01	1	9			
<u>Average Acuity</u>					
<1.96	13	10			
1.97 - 2.08	2	8			
2.09 - 2.29	5	13			
2.3 - 2.43	3	5	.334	.253	-
2.44 - 2.67	2	5			
2.68 - 2.83	2	2			
3 - 3.5	2	-			
>3.6	3	5			
<u>Census</u>					
<5	8	5			
6 - 10	10	7			
11 - 15	9	13			
16 - 20	3	12	.374	.083	-
21 - 25	1	6			
26 - 30	1	3			
>30	-	2			

Table 7 (continued)

	<u>Staffing</u>				
Variable	Recommended	Variant	Cramer's V	P	Lambda
<hr/>					
<u>Day of Week</u>					
Sunday	4	5			
Monday	5	8			
Tuesday	5	9			
Wednesday	5	11	.149	.939	-
Thursday	5	6			
Friday	3	5			
Saturday	5	4			
<u>Shift</u>					
Day	10	28			
Evening	10	12	.287	.037	.125
Night	12	8			

### Staffing Level and Type of Incident

Chi-square analysis of type of incident with the known staffing level is shown in Table 8. In order to use this test, NCH variance data were grouped into recommended and variant staffing level groups. There was no statistically significant difference between the staffing levels and type of incident. Staffing level was not associated with a particular type of incident.

As the data collected in the first part of the study were only for time periods when an incident occurred, it was impossible to determine a relationship between staffing and incident occurrence. Thus, these findings provided information only on the variables at the time of the incident.

### Staffing and Incident Rate

A second set of analyses examined workload and incident data from one medical-surgical unit (A) for a 6-month period, June 1990-December 1990. Data were drawn from 213 workload management summaries. Staffing data for every day were included, regardless of incident occurrence, to discover if staffing levels and incident occurrence were related.

Table 9 shows the NCH variance, average acuity, census, RN utilization rate, non-RN utilization rate, and required NCHs from June 1990 to December 1990. During this period, 18 incidents occurred. NCH variance was -104 hours to 152

Table 8

Analysis of Staffing Level and Type of Incident for  
All Units, June 1990-December 1991 (N=80)

Staffing Level	<u>Type of Incident</u>					
	Fall	Medication	Procedure	IV	Complaint	Other
Variant	10	14	1	1	6	3
Recommended	7	26	2	-	7	3
Total	17	40	3	1	13	6

Pearson = 2.44  
 DF = 5  
 P = .786

Table 9

NCH Variance, Average Acuity, Census, RN Utilization Rate,  
Non-RN Utilization Rate, and Required NCH, June 1990-  
December 1990 (N=213)

Characteristic	Mean	SD	Range
NCH Variance	15.33	±37.36	-104 - 152
Average Acuity	1.99	± .32	1.17 - 4.00
Census	15.76	± 6.42	3 - 32
RN Utilization Rate	1.20	± .40	.5 - 2.33
Non-RN Utilization Rate	1.20	± .56	.0 - 3.00
Required NCH	84.34	±41.02	7 - 191

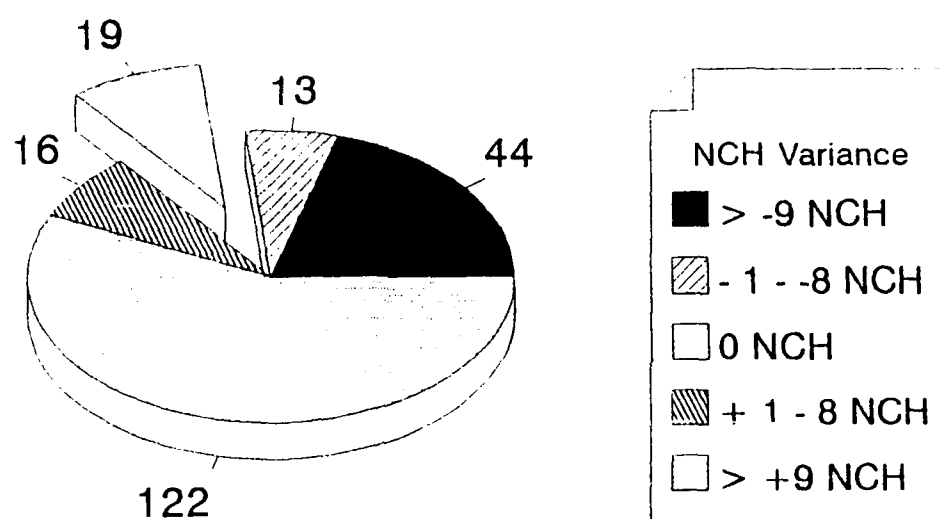
Table 10

Frequency and Percent of NCH Variance,  
RN Utilization, Non-RN Utilization, Average  
Acuity, and Census, Medical-Surgical Unit A,  
June 1990-December 1990 (N=213)

Characteristic	n (%)
<b><u>NCH Variance</u></b>	
> -33	18 ( 8.5)
-25 thru -32	8 ( 3.8)
-17 thru -24	9 ( 4.2)
- 9 thru -16	8 ( 3.8)
- 1 thru - 8	13 ( 6.1)
0	19 ( 8.9)
1 thru 8	16 ( 7.5)
9 thru 16	25 (11.7)
17 thru 24	12 ( 5.6)
25 thru 32	26 (12.2)
> 33	59 (27.7)
<b><u>RN Utilization Rate</u></b>	
1.00	44 (20.7)
< .99, > 1.1	169 (79.3)
<b><u>Non-RN Utilization Rate</u></b>	
1.00	38 (17.8)
< .99, > 1.1	175 (82.2)
<b><u>Average Acuity</u></b>	
<1.54	16 ( 7.5)
1.55 thru 1.83	39 (18.3)
1.84 thru 1.96	39 (18.3)
1.97 thru 2.02	25 (11.7)
2.02 thru 2.15	46 (21.6)
>2.15	48 (22.6)
<b><u>Census</u></b>	
3 thru 9	40 (18.8)
10 thru 14	58 (27.2)
15 thru 18	44 (20.7)
19 thru 23	43 (20.2)
24 thru 32	28 (13.1)

Table 10 (continued)

Characteristic	n (%)
<b><u>Type of Incident</u></b>	
Medication Error	9 (50)
Patient Fall	6 (33.3)
Procedure	1 ( 5.6)
Complaint	1 ( 5.6)
Other	1 ( 5.6)



Daily Workload Periods (N=213)

Figure 5. Descriptive statistics.

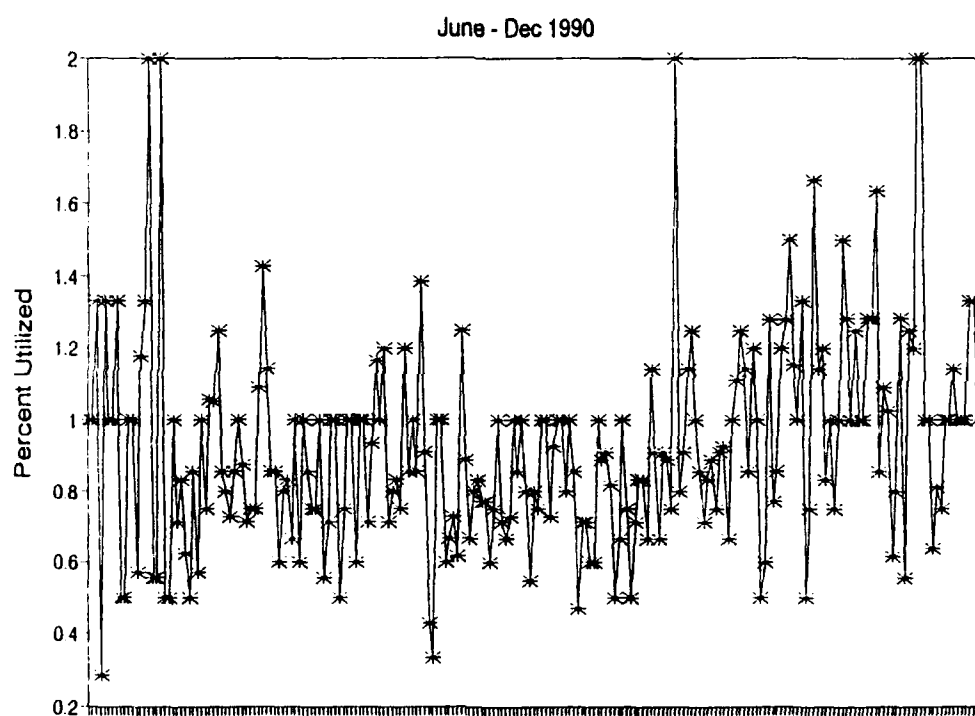


Figure 6. RN utilization rate

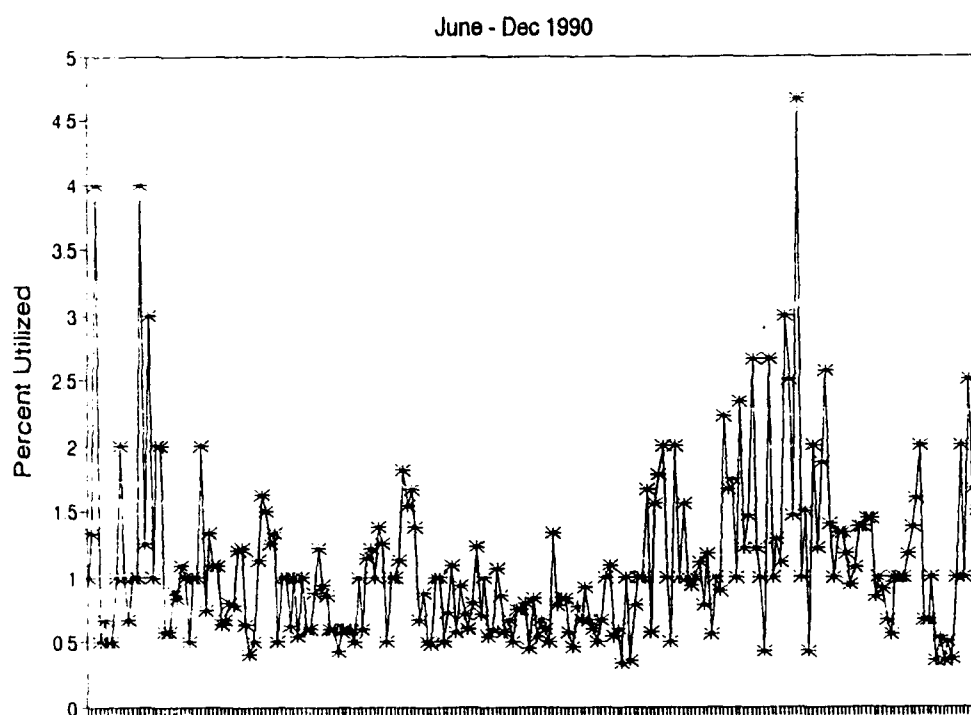


Figure 7. Non-RN Utilization Rate

hours. Average acuity was 1.17 to 4.00. Census fluctuated between 3 and 32 patients.

Table 10 shows the frequency and percent during the study period of unit characteristics: NCH variance, RN utilization rate, non-RN utilization rate, average acuity, census, and type of incident. Fifty-nine 24-hour periods (27.7%) had a NCH variance of  $> 33$  hours. With 8 NCH hours equivalent to one FTE, the unit was variant--either understaffed (16.5%) or overstaffed (45.5%) by three FTEs--62% of the time. Viewing recommended staffing (required FTEs = actual FTEs) and variant staffing (over- or understaffed by one or more FTEs), the unit was found to be understaffed 26.4% and overstaffed 64.7% of the total time; in other words, the unit had variant staffing 91.1% of the time (see Figure 5). When the RN utilization rate was recorded into recommended (1.00) and variant ( $< .99$ ,  $> 1.1$ ) staffing levels, the recommended RN utilization rate occurred 20.7% of the time and a variant rate occurred 79.3%. Recommended rates for non-RN utilization occurred only 17.8% of the time (see Figures 6 and 7).

Average acuity ranged from 1.7 to 4.00. Acuity was above 2.15 for 48 periods (22.6%) and below 1.54, for 16 periods (7.5%). Census ranged from 3 to 32. For 27% of the time, census was 10 to 14 patients, for 13% of the time it was 24 to 32 patients, and for 41% of the time, census was 15 to 23 patients. Eighteen incidents occurred, of which medication errors were the most frequent.

The Pearson Product Moment correlation coefficient was used to generate a correlation matrix for certain model variables (incident occurrence, census, average acuity, RN utilization rate, non-RN utilization rate, and NCH variance). Table 11 details the results for the 6-month period. As hypothesized, the dependent variable of incident occurrence correlated significantly with non-RN utilization rate ( $r = -.141$ ,  $p = .05$ ) and NCH variance ( $r = -.187$ ,  $p = .01$ ). There were other significant correlations between the model variables. NCH variance and non-RN utilization rate were highly correlated ( $r = .845$ ,  $p = .01$ ). During this 6-month period, when more NCH hours were available than needed, non-RNs were more understaffed. A low correlation was found between RN utilization rate and non-RN utilization rate and NCH variance. An inverse relationship existed between the NCH variance and utilization rates (RN and non-RN), census and average acuity.

In order to analyze the relationship between NCH variance, RN and non-RN utilization rates and the occurrence or non-occurrence of incidents, cross-tabulation of data was performed. This analysis is shown in Table 12. Since the independent variable, incident occurrence, was nominal, Cramer's V or Fisher's exact probability was used to determine statistical significance. If statistical significance between the groups occurred, Lambda was used to note PRE. The levels of NCH variance, RN utilization and

Table 11

Pearson Correlation Coefficient for Incident Occurrence, RN Utilization Rate,

Non-RN Utilization Rate, NCH Variance, Census, and Average Acuity

Variable	Incident Occurred	RN Rate	Non-RN Rate	NCH Variance	Census	Average Acuity
Incident Occurred	1.00	-0.027	-.141*	-.187**		
RN Rate	-0.027	1.00	.401**	.421**	-.348**	-.273**
Non-RN Rate	-.141*	.401**	1.00	.845**	-.585**	-.206**
NCH Variance	-.187**	.421**	.845**	1.00	-.453**	
Census		-.348**	-.585**	-.453**	1.00	
Average Acuity		-.273*	-.206**	-.145*		1.00

\* p = .05; \*\* p = .01

Table 12

Analysis of Incident Occurrence for NCH Variance,  
RN Utilization Rate, and Non-RN Utilization Rate,  
Medical-Surgical Unit A, June 1990-December 1990 (N=213)

Factor	Incident Occurrence		Cramer's V	P	Lambda
	No	Yes			
<b><u>NCH Variance</u></b>					
-9 thru -64	37	6			
-1 thru - 8	10	3			
1 thru 8	13	3	.224	.032	.032
8 thru 152	117	5			
0	18	1			
<b><u>RN Utilization Rate</u></b>					
<.5	4	2			
.51 thru .99	38	5			
1.01 thru 1.5	87	-	.304	.000	.041
>1.5	27	6			
1.00	39	5			
<b><u>Non-RN Utilization Rate</u></b>					
<.5	13	7			
.51 thru .99	53	1			
1.01 thru 1.5	42	2	.335	.000	.023
>1.5	54	3			
1.00	33	5			

non-RN utilization rates were significantly different for incident occurrence. An association between these three variables and incidence occurrence was shown.

Data on NCH variance, RN utilization rate, and non-RN utilization rate were recoded to reduce the number of empty cells. When chi-square and Fisher's exact tests were performed, no significant difference in incidence occurrence based on NCH variance or staff utilization rate was seen (Table 13).

An analysis of the relationship between NCH variance, RN utilization rate and non-RN utilization rate and the type of incident was conducted through cross-tabulation (Table 14). No statistically significant difference in type of incident occurred between the staffing variations.

To analyze the difference between the groups in which an incident occurred or did not occur, the t-test was used. The results appear in Table 15. A significant difference was noted between the group with incident and the group without incident, for NCH variance and for non-RN utilization rates.

Data on variance in nursing care hour (NCH) were recoded into groups representing FTEs (8 hours = 1 FTE; see Table 16). Group 2 (short 4 FTEs) and Group 4 (short 2 FTEs) had the highest incident rates. Although the group differences were statistically significant, the Scheffe test produced no significant difference between any two groups at the .05 level.

Table 13

Analysis of Incident Occurrence for Staffing Level,  
RN and Non-RN Utilization Rates, Medical-Surgical Unit A,  
June 1990-December 1990 (N=213)

Factor	Incident Occurrence		Pearson	DF	P	Fisher's Exact
	No	Yes				
<b><u>Staffing Level</u></b>						
Recommended	18	1	.274	1	.601	.506
Variant	177	17				
<b><u>RN Utilization Rate</u></b>						
100%	39	5	.608	1	.435	.304
Not 100%	98	13				
<b><u>Non-RN Utilization Rate</u></b>						
100%	33	5	1.32	1	.250	.198
Not 100%	162	13				

Table 14

Analysis of Type of Incident and Staffing Level, RN and  
Non-RN Utilization Rates, Medical-Surgical Unit A,  
June 1990-December 1990 (N=18)

Staffing	<u>Type of Incident</u>					DF	Pearson	P
	1	2	3	4	5			
<b><u>NCH Variance</u></b>								
> 1 FTE short	1	3	0	1	1	16	22.5	.128
1 FTE short	2	0	1	0	0			
Recommended	0	1	0	0	0			
1 FTE over	3	0	0	0	0			
> 1 FTE over	0	5	0	0	0			
<b><u>RN Utilization Rate</u></b>								
< .99, > 1.01	4	7	1	1	0	4	3.60	.463
1.00	2	2	0	0	1			
<b><u>Non-RN Utilization Rate</u></b>								
< .99, > 1.01	3	7	1	1	1	4	2.80	.597
1.00	3	2	0	0	0			

Note: 1 = Patient fall  
 2 = Medication error  
 3 = Procedure error  
 4 = Complaint  
 5 = Other

Table 15

Analysis of Interval-Level Variables on Incident  
Occurrence, June 1990-December 1990 (N=213)

Variable	No Incident (n=195)		Incident (n=18)		F	P
	Mean	SD	Mean	SD		
NCH Variance	7.54	±3.52	5.17	±2.99	1.38	.006
Average Acuity	1.99	± .32	1.96	± .26	1.59	.687
RN Rate	3.63	±1.26	3.50	±1.92	2.32	.788
Non-RN Rate	3.64	±1.69	2.78	±1.83	1.18	.041
Census	15.69	±6.51	16.44	±5.42	1.44	.635

Table 16

ANOVA by NCH Variance Group for Incident  
Occurrence, June 1990-December 1991

Group	n	Mean	SD		
1 (-5 FTE)	18	.0556	.2357		
2 (-4 FTE)	8	.2500	.4629		
3 (-3 FTE)	9	.1111	.3333		
4 (-2 FTE)	8	.2500	.4629		
5 (-1 FTE)	13	.2308	.4385		
6 (recommended)	19	.0526	.2294		
7 (+1 FTE)	16	.1875	.4031		
8 (+2 FTE)	25	.1600	.3742		
9 (+3 FTE)	12	.0000	.0000		
10 (+4 FTE)	26	.0000	.0000		
11 (+5 FTE)	59	.0169	.1302		
Source	df	SS	MS	F	p
Between groups	10	1.61	.161	2.19	.0199
Within groups	202	14.87	.073		

Linear regression was used to examine the significant relationship between NCH variance and incident occurrence found during the correlation analysis. This established the amount of variance in incident occurrence that could be explained by NCH variance (see Table 17).

The t statistic for NCH variance by group as a single predictor was significant ( $p = .0062$ ). However, Table 17 shows that only 3.5% of the variance was explained using NCH variance (adjusted  $R^2 = .03$ ).

To test the hypothesis that there was no linear relationship between NCH variance group and incident occurrence, analysis of variance was conducted. The hypothesis was rejected, as the significance of the F statistic was  $< .05$ .

Table 18 shows the non-linear regression for incidents and NCH variance. R squared is the proportion of the total variation of incidents that can be explained using NCH variance and the fitted model. None of the incidents could be explained using this model.

Table 17

Linear Regression Table for NCH Variance  
and Incident Occurrence, June 1990-December 1990

	<u>B</u>	<u>SE B</u>	<u>T</u>	<u>Sig T</u>	<u>Multiple R</u>	<u>R<sup>2</sup></u>
NCH Variance	-.015	.005	-2.77	.0062	.187	.035

Adjusted R<sup>2</sup> = .030; F = 7.646; p = .006

Table 18

Non-linear Regression For Incidents and NCH Variance

Source	DF	Sum of Squares	Mean Square
Regression	3	1.521	.5070
Residual	210	16.479	.0785
Uncorrected Total	213	18.000	
(Corrected)	212	16.479	
R squared = 1 - Residual SS/Corrected SS = .0000			

### Discussion

Analysis of the data supported the hypothesis that more incidents occur at variant staffing levels. Of the 80 incidents during the period studied, 60% happened when there was a variance between recommended NCH and actual NCH available. This finding is consistent with the earlier studies by Abdellah and Levine (1979) and Bryant et al. (cited in Abdellah & Levine, 1979). It also supports Helt and Jelinek's (1988) claim that above or below standard staffing levels, quality of care decreases. This finding is consistent with those of Flood and Diers (1988), that nursing units with variant staffing had higher complication rates.

More incidents occurred on the medical-surgical units than on all other units. Several unusual events may be relevant to this finding. Because of Desert Shield/Desert Storm, the SCU was closed for a number of months. In addition, the number of deliveries per month were also reduced during this period. A number of reservists were brought into the hospital to work on the medical-surgical units. These changes may account for the two medical-surgical units having a higher incident rate.

At this hospital, nurses have been urged especially to report medication errors. Medication errors and patient falls have been high-interest errors within this facility and its parent hospital system. This may account for the frequency of these types being reported.

A significant finding was that the incident rate rose when a NCH variance was due to variant RN utilization rate, but not when it was due to a variant non-RN utilization. This finding is consistent with Munroe's (1990) study in nursing homes, which found that the mix of nursing personnel was more important than the number of nursing personnel available.

Blake and Morfitt (1986) found a significant difference in the number of falls according to the time of day, which they related to the nursing personnel available. They found more falls occurred at night, when fewer staff were available. The present study, however, found the opposite to be true. More incidents occurred during the day shift. Staffing comparisons among shifts are difficult; this study found that there was more variant staffing on day shifts than on night shifts, but the variations were due to both understaffing and overstaffing. Since the night shift had the recommended staffing more often and the least number of incidents, it appears that staffing level is a determinant of incident occurrence. It should be noted, however, that the level of incidents was too low to allow more refined statistical testing.

The Jones and Smith (1989) study reported a need for uninterrupted time for nurses giving medications, and for more frequent room checks during certain time periods. With more staffing variance, one can presume there may be more

interruptions. This could explain the increased number of medication errors with variant staffing levels. In addition, with variant levels, room checks may not be done as frequently, which would explain why more falls occurred.

An interesting finding is that staffing level did not appear to be a factor in the number of patient/physician complaints. This finding is similar to Abdellah and Levine's 1958 study (cited in Abdellah & Levine, 1979) in which some groups within the hospital felt certain aspects of nursing care were omitted regardless of the number of kind of nursing hours provided.

The t-test and chi-square analysis of incident data did not reveal information about the relationship between staffing level and incident occurrence. The findings were that there were differences between the two groups of staffing data in terms of utilization rates for RNs and for non-RNs, and the nursing units. This meant that the units differed significantly in their ability to provide recommended staffing levels, and the utilization rates differed according to the staffing level.

The type of incident did not vary significantly with the staffing level. This is contrary to findings of Blake and Morfitt (1986), Poster and Pelletier (1988), and Hoffman et al. (1990).

The findings from the second part of the study revealed a significant difference between staffing level and both RN

and non-RN utilization, for incident occurrence. This important discovery supports the findings of Helt and Jelinek (1988), Flood and Diers (1988), Behner et al. (1990), and Munroe (1990). In addition, the RN utilization rate revealed a stronger association with incident rates ( $\Lambda = .041$ ) than did the other two variables, a finding similar to Munroe's.

Helt and Jelinek (1988) reported a nonlinear relationship between quality of care and nursing staff. Behner et al. (1990) were also able to find a relationship between staff levels and patient outcomes and complications. When a similar attempt was made in this study, by recoding the NCH variance into recommended and non-recommended levels, and utilization rates, there was no significant difference between the groups, contradicting these previous studies. This, however, may be due to the way the levels were set and the limited number of observations.

Previous studies (Blake & Morfitt, 1986; Flood & Diers, 1988; Jones & Smith, 1989; Marchette & Holloman, 1986; Poster & Pelletier, 1988) have recommended looking at variation between recommended and actual staffing and a measure of quality care. This study found significant differences for incident occurrence between NCH variance and non-RN utilization rate. Although this finding supports the hypothesis that staffing and incident occurrence are related, it was not possible to define the relationship in terms of prediction.

Although NCH variance was significant ( $p = .006$ ) in explaining the variance of incident occurrence, the coefficient was so low ( $R^2 = .0349$ ) as to be unimportant. This relationship could not be defined using nonlinear regression as in the Helt and Jelinek (1988) study.

The limitations of this study prevent generalizing of the findings. Aside from the use of a convenience sample, the multiple structural and contextual factors which influence patient care make it difficult to measure an association between staffing level and quality of care. During the period studied, several changes affected the nursing units. A number of the more experienced nursing personnel and physicians left suddenly to support military operations, which changed staff composition, experience levels, and physician practice patterns. The study assumed that incidents were discovered and reported, but incidents may not have been reported. Using incidents, a nominal measure (incident/no incident), as a measure of quality prevented data analysis with higher-level statistics. In addition, in the 6-month analysis the limited number of incidents (18) precluded clear identification of relationships.

In summary, the staffing levels showed significant differences in incident occurrence, supporting the conclusion that staffing variance does relate to incident occurrence. Variant staffing patterns were associated with increased

incidents. When the analysis included data for periods when no incident occurred, staffing levels still showed significant differences in the rate of incident occurrence. The exact relationship between staffing levels and staff utilization, however, was not apparent.

Chapter 5  
SUMMARY, CONCLUSIONS, IMPLICATIONS  
AND RECOMMENDATIONS

The purpose of this study was to measure the rates of nursing incidents at different staffing levels, and to examine the relationship between the rate of nursing incidents and staffing adequacy on units in one medical treatment facility. The motivation for the study was the absence of research on staffing and rate of utilization as defined by a patient classification system, and the effect on nursing incident occurrence when understaffing or overstaffing occurs. Many nurses believe understaffing increases the likelihood of incident occurrence, and in this belief they support staff increases. It is hoped that evaluating this relationship in one military health care facility will further research in this area.

This study utilized a pre-experimental, ex post facto (Polit & Hungler, 1987) design. Incident reports (N=80) and workload management summary reports (N=213) were used for data collection. The study group consisted of six nursing units in a 70-bed military medical facility. All the units demonstrated variant and recommended staffing levels during the study period, and incidents occurred on each unit.

### Summary and Conclusions

The null hypothesis tested was: recommended staffing levels and variant staffing levels will have the same number of nursing incidents. In the first part of the study, an incident occurrence was used as the unit of analysis. Variant staffing levels produced more incidents than recommended staffing levels, although this result may have been affected by variables other than staffing patterns. For example, level of staff experience, changes in physician practice patterns, support system inadequacy, staff morale, and staff job satisfaction were outside the scope of this study. The finding remains, however, that incidents occurred more frequently with variant staffing than when recommended staffing was available.

The time of day appeared significant. More incidents occurred during the day, and variant staffing was more often used during the day. The data on frequency of incidents during the day may have been affected by more senior managers being available to discover and report the incidents. Even if it occurred on another shift, however, an incident could be reported at anytime and still be recorded for the shift on which it occurred. This consideration supports the conclusion that staffing level had more of an impact on the incident rate than did the time of day.

The second part of the study addressed the relationship between staffing level and incident occurrence. Workload

data from each 24-hour period on a single nursing unit were examined to determine staffing variance. Incident occurrence was compared between periods with staffing variance and periods with recommended staffing.

A major finding was that in the 6-month study of a single medical-surgical unit, variant staffing occurred over 90% of the time. This supports the conclusion that more incidents occur at variant staffing levels because such levels are the mode of the unit.

Using chi-square analysis, NCH variance and utilization rates did not differ for incident occurrence. This may be due to the small sample size and the small number (N=18) of incidents.

Even so, incident occurrence rates did differ among recommended and variant staffing levels, non-RN utilization rates, and NCH variances. When data were aggregated into two large groups, namely recommended staffing pattern only and all other patterns, the occurrence of incidents did not differ significantly between the recommended staffing and the variant staffing groups. This finding may mean that the relationship between staffing level and incident occurrence is reflected more accurately in analysis of small changes in staffing levels than in an aggregate comparison of recommended versus variant levels.

Staffing level was a significant predictor of nursing incidents. The staffing levels, however, only explained 3.5%

of the variance of incident occurrence ( $R^2 = .0349$ ). The null hypothesis, staffing level is not predictive of nursing incident occurrence, was rejected (significance of  $F = < .05$ ). Moreover, when other variables (average acuity, census, and utilization rates) were considered along with staffing level, the null hypothesis was again rejected. The low coefficient may be due to the many other factors other than those studied which affect patient outcomes and nursing incidents and, also small sample size.

#### Implications for Nursing Administrative Practice

This study provides information on the relationship between staffing levels and incident occurrence. The relationship of utilization rate and other variables to incident occurrence and to type of incident were also explored.

To promote labor efficiency without diminishing the quality of care, it is important to understand the impact of such structural variables as staffing and the patient classification system on patient outcomes. Since nursing incidents may lead to negative patient outcomes--complications, longer length of stay, or dissatisfaction with care, for example--nurse executives should understand those factors promoting negative occurrences that are within their control.

Labor efficiency is essential to hold down labor costs. With the large increases in health care costs, nurse administrators must understand levels of labor efficiency well enough to know when inefficiency, or too much efficiency, is deleterious to organizational or patient outcomes.

Another important organizational outcome is staff satisfaction. Information generated from studies such as this can help nurses decide which levels of staffing promote more incidents, and which levels are preferable because they enable safe practice.

Nurse administrators must justify the number of FTEs they request for nursing care. The justification rests on the relationship between staffing level and quality of care. A nurse administrator should also be able to pinpoint critical staffing levels. This study casts light on what range of staffing levels is safe, helping to ensure wiser decisions about closing units, transferring patients, or limiting admissions.

Issues of timing and staffing levels can also be reviewed in the light of findings from this study. The relationship between day of week, time of day, staffing levels, utilization rates and incident occurrence can be evaluated. This important information will help nurse administrators allocate resources over the day and the week. Most plans staff more heavily during the day and on weekdays.

On any given unit it may be more appropriate to increase staff on the evening shift or the weekend.

The relationship between staffing level and type of incident needs further definition. Causes of falls and medication errors have been studied; however, such studies often do not examine staffing levels and utilization rates. When trying to reduce particular types of incident, the nurse administrator must be able to identify the factors that are most important to change. If staffing is not a strong predictor of incidents, for example, it behooves the nurse administrator to concentrate on other structural processes to control incidents.

Most nurses want to give the very best patient care possible. When the resources are not available to meet that standard, however, it is important to nurses to know the conditions under which it is still possible to provide safe and adequate care. Information on variant staffing levels and measures of quality of care can show nurses where on the continuum of care they can practice with a given level of resources. Such understanding may help to prevent nurse dissatisfaction and "burnout."

It is also useful for patients to know what happens with limited resources. Patient satisfaction is often scored on whether a patient's particular expectation was met. Research such as the present study can be used to educate patients about the way different levels of care are based upon resource availability.

The relationship between nursing incidents and staff utilization is useful for deciding on staff mix. In military facilities, nurse executives have little say on staff mix. But with information of this kind, they can more authoritatively identify the best ratios of non-RNs to RNs.

When looking at these relationships, Roy's adaptation model can be used as a theoretical basis for nursing administration practice. This model fits well with contingency theory (Fawcett, Botter, Burritt, Crossley, & Frank, 1989).

The Roy adaptation model is based on systems and adaptation theories. Using Roy's model, nursing administration is viewed as an adaptive system encompassing person (nursing administration), health (health of the nursing managerial systems), environment (external and internal environments of the organization and people), and nursing (administrative decision making) (DiIorio, 1989).

Through the use of Roy's adaptation model and contingency theory, the nurse administrator can more fully understand what structures (e.g., patient classification system, staffing levels, utilization rates) will promote the best organizational outcomes (e.g., patient satisfaction, lower incident rates). Adapting these structures to the environment enhances outcomes.

### Recommendations for Future Research

1. Replication of this study with a larger sample of nursing workload data over a longer time frame in several military health care facilities, using a quality-of-care indicator based on interval-level data.

2. Replication of this study using data on variant and recommended staffing with both under-utilization and over-utilization of RNs to understand the relationship between RN utilization rate and staffing level as well as their combined impact on the quality of care.

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APPENDIX A  
ORGANIZATIONAL PERMISSION TO CONDUCT STUDY



**DEPARTMENT OF THE AIR FORCE**  
1ST MEDICAL GROUP (TAC)  
LANGLEY AIR FORCE BASE VA 23665-5300

REPLY TO  
ATTN OF CC

30 September 1991

SUBJECT: Permission to Conduct Research Study (Your Ltr, undated)

TO: Lt Col Susan J. Helm

Requested research study is approved. Your hypothesis makes sense; I would appreciate reading your findings.

ANTHONY M. POLICASTRO, Colonel, USAF, MC  
Commander

*Readiness is our Profession*

APPENDIX B  
DATA COLLECTION FORM

